

Summary & Recommendation

The on-site quality assurance and inspection of the Unit 1 (U1) HP turbine rotor, diaphragms, buckets, and high speed balance witnessing was done at Alstom, Rugby, United Kingdom between December 1 and 7, 2002.

The primary work scope consisted of a spot check and visual inspection of the fit, clearances, coupling, bearing journal, rotor run out, control rotor machining, and dynamic over speed balancing. The overall HP rotor high speed's peak-to-peak vibration was extremely good with the maximum displacement at the 2nd critical speed (4170 rpm) of 0.0002". (Refer to Appendix B.)

In addition, the last Unit 2 (U2) turbine outage check list, and the upcoming U1 turbine outage work scope, including the possible U1 IP Faro Arm measuring were discussed. The March 2002 U2 outage report indicated severe damage on the IP 8 th stage double flow diaphragms, the 8 th stage bucket, and excessive run out (7 mils TIR) on the IP rotor. The 9 th, 10 th, 11 th, and 14 th stage diaphragms also subjected to FOD damages. The reports recommend to (a) replace, on the next HP/IP outage window, the 8 th stage buckets, (b) repair/replace the 8 th, 9 th, 10 th, 11 th, and 14 th stage diaphragms, and (c) re-machine the IP rotor if run out is progressing to the maximum allowable limit of 10 mils. However, replacing the existing IP rotor and diaphragms with a more efficient dense pack is surely an alternative to maximize the turbine reliability and efficiency. Economic, safety, and operational reliability analysis would identify the best resolution.

The March 2003 U1 HP/IP turbine overhaul provides a unique opportunity for measuring the IP. Alstom's Faro Arm measuring devices and technicians are already scheduled to be onsite during this outage for the U1 HP retrofit. Alstom would provide this service at no cost, without any interference with the outage. Therefore, it is recommended allowing Alstom to measure the U1 IP during the upcoming March 2003 outage.

Concerns of the HP end balance hole line up, low speed balance, startup and performance testing were also resolved.

Alstom strongly recommends keeping the high speed (factory) balanced weights on turbine rotors during low speed balancing. Throughout their retrofit experiences, removal of all high speed factory weights proved to cause a significant vibration and troublesome startup. The issue has been discussed with IPSC's Performance Group. Alstom formal letters of recommendation (LOR) will be issued at a later date.

(12/10/02)

U1 HP Factory Inspection - 1



New technology of the shell horizontal hydraulic bolts was presented by Hydratight Sweeney Comp. of England and Technofast Comp. of Australia. The hydraulic bolting system has been used widely with good success over the past 14 years within power generation, mining, steel, petroleum, and civil industries. The new hydraulic bolting technology would reduce our turbine shell bolting/unbolting time, a critical path of the turbine overhaul, from 20 hours to four hours, average. Additional studying/cross check of this technology is currently being conducted by IPSC Engineering.

The factory-built final report and associated drawings will be supplied by Alstom by the 2^{nd} week of February 2003.

The U1 HP rotor and cylinder will be shipped by the 1^{st} week of January and will be on the site by the 2^{nd} week of February 2003.



Process Control Guides

Activity Description	QA Instructions References	Comments	Verified Date
A coupling, HP half	Alstom/GE	Completed	12/02
Inner shell feeler check	Alstom/GE	Carried Out	12/02
Rotor run out	Alstom/GE	Completed	12/02
Packing and wheel clearances	Alstom/GE	Carried Out	12/02
NDE reports on rotor, shell, diaphragms, bolts, casing	Alstom/GE	Carried Out	12/02
T1 & T2 journal areas	Alstom/GE	Completed	12/02
Diaphragm sideslips	Alstom/GE	Carried Out	12/02
Control coupling, HP half	On the U2 Alstom HP control rotor, there were only eight tapped holes whereas the control rotor had twelve bolt holes and four jacking holes.	Completed	12/02
HP rotor machining drawing Alstom R201/A0/3249 update	Update the drawings to the new hole numbers and dimensions	Completed	12/02
HP U1 1% flow reduction (6,915,600 lb.hr) by changes made to stage 1 and 6 diaphragms (fixed blades)	Check the drawing, part identification.	Completed	12/02
HP End Balance Holes Line Up	Obtain drawings & details of drill & tap Obtain details for new plugs Measurements Incorporate these steps into Alstom installation time line/program	Completed	12/02
Review Alstom Work Built Report	Check clearances, run out	Carried Out	12/02
Retractable diaphragm packing	Alstom/GE	Carried Out	12/02
Onsite radial and axial clearances	Alstom/GE	Carried Out	12/02

(12/10/02)

U1 HP Factory Inspection - 3



Activity Description	QA Instructions References	Comments	Verified Date
A coupling honing and machining	Alstom/GE	Carried Out	12/02
Control coupling honing and machining	Alstom	Completed	12/02
High Speed Balance	Alstom/GE	Completed	12/02
Balancing Weight	Alstom/GE	Completed	12/02
Thread chaser and other tools	Alstom/GE	Completed	12/02
U2/U1 performance	Go over the test tolerances	Completed	12/02
Low Speed Balance	Low speed balance procedure	Completed	12/02
Outage planning, startup	As required	Completed	12/02



High Speed Dynamic Balancing

The high speed dynamic balancing was completed twice, with five minutes over-speed intervals, on the Unit 1 HP completed bladed rotor. The rotor went through the $1^{\rm st}$ critical (1930 rpm) and $2^{\rm nd}$ critical (4170 rpm) speeds with exceptionally low vibration. The maximum peak-to-peak displacement vibration is 3.6 micro inches (0.0002"), better than that of the U2's HP (13.6 micro inches.) The Alstom maximum acceptable is 16.0 micro inches and GE maximum acceptable is 25.0 micro inches. Refer to the Table 1 and attached graphs.

	Vibration,	Displacement, Peak-to-Peak		
Speed, rpm	HP Rear, in	HP Front, in	Comment	
1850	0.00002	0.00002		
3600	0.00001	0.00004		
3960	0.00010	0.00008		
4170	0.00020	0.00005		
4320	0.00007	0.00015		

Rotor Run Out

All rotor's run out dimensions are found to better than the limits. Refer to the attached drawing.



APPENDIX A - ROTOR RUN OUT



APPENDIX B - HIGH SPEED BALANCE



APPENDIX C - HORIZONTAL JOINT HYDRAULIC BOLTING



APPENDIX C - IP STEAM PATH REPAIR & FARO ARM MEASURING



APPENDIX D - LOW SPEED BALANCE



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APPENDIX A - ROTOR RUN OUT



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APPENDIX C - HORIZONTAL JOINT HYDRAULIC BOLTING



APPENDIX C - IP STEAM PATH REPAIR & FARO ARM MEASURING



APPENDIX D - LOW SPEED BALANCE

Unit 2 HP (High Pressure) Dense Pack Replacement

The existing turbine at IPSC is a General Electric, tandem compound; 820,000 kw with rated steam at 2,400 psig; 1000° F main steam and reheat; a flow rate of six million pounds of steam per hour; Model No. 270T150 Code S2, with one single-flow double-nozzle box HP (high pressure) turbine, one double-flow IP (intermediate pressure) turbine, and three double-flow LP (low pressure) turbines with 30 inch last stage blades. Damage due to SPE (solid particle erosion) is reported to be extensive on the nozzle boxes of both HP and IP turbines. The sectionalized overhaul requires that the HP and IP nozzle boxes be weld-repaired and high velocity coated.

Replacement of the existing HP, double-flow nozzle, six-stage, partial arc admission turbine with a new dense pack, single-flow nozzle, seven-stage, full arc admission turbine would improve the HP efficiency by 2 percent or more and would minimize the SPE concerns.

GEC Alsthom (Alstom) will provide the HP inner shell, nozzle boxes, rotor, diaphragms, and other interface components.

Retrofitting the HP turbine requires some modifications on the turbine subsystems, control systems, EHC, main control valves, and couplings.

With the above work scopes, we, at IPSC, are excited for the upcoming Unit 2 Spring 2002 Outage.

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: George W. Cross

Page <u>1</u> of <u>1</u>

FROM:

Dennis K. Killian

DATE:

February 13, 2002

SUBJECT: Summary of HP Retrofit Interface Changes

We recommend religiously following the shutdown, startup, and operation of the turbine in accordance with the GE existing procedures. According to Alstom, the operation procedures, including startup and shutdown of the retrofitted turbine, are the same as the exiting GE procedures. However, the reduction of the radial spill strip and turbine end axial clearances require absolute, mandatory adherence to the GE procedures. The eccentricity, rotor prewarming, chest warming, steam-to-turbine temperature matching, thermal stress control, differential expansion, and speed hold mandatory procedures are critical for a successful turbine operation.

The HP retrofit consists basically of a new rotor and a new inner cylinder assembly consisting of diaphragms, variable packings, and steam inlet connections. The original HP outer shell, N1 and N2 packing casings, and packing rings retained.

Control of steam entering the HP is converted to full arc admission. Generally the instrumentation is arranged to monitor the same conditions as before to minimize disturbance of existing systems. The option of using the partial arc mode to control rotor long will no longer be available.

Major interface changes and effects are listed in Table 1 below.

Please direct questions or comments to Phong Do at ext. 6475.

PTD/JKH:jmg Attachments

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	TABLE 1 - INTERMOUNTAIN POWER GENERATION TURBINE RETROFIT MAJOR INTERFACE LIST					
No	Description	Alston	GE	Effect or Comments		
1	Critical Speed, rpm • 1 st • 2 nd	~1750 ~4300	~1950 ~4550	None None		
	Control Valve Change to Full Arc	Full Arc	Partial or Full Arc	All four CVvs open simultaneously. There will no longer be any choice between partial arc and full arc operation. In the event of a closure of any one HP control valve due to a fault, unrestricted operation is permitted. ALSTOM is providing (through Novatech) new digital position boards for the HP control valves. Some minor wiring changes will also be required within the governor panel and full instructions for this work will be provided. Following fitting of the new boards, it will be necessary to stroke the valves to set up the full open and full closed positions.		
	Startup	No Change	GE	No change. All starts are to be performed to the existing GE instructions using HP inlet inner surface temperature in place of 1 st stage inner surface temperature. However, the reduction of the radial spill strip and turbine end axial clearances require an absolute mandatory of the GE procedures.		
	Shutdown	No Change	GE	All shutdowns are to be preformed to the existing GE instructions.		
	Normal Operation	No Change	GE	Operation, rates of loading and unloading remain as per the existing GE instructions.		

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	TABLE 1 - INTERMOUNTAIN POWER GENERATION TURBINE RETROFIT MAJOR INTERFACE LIST					
No	Description	Alston	GE CONTRACTOR	Effect or Comments		
	Radial Clearances N2 Packing N1 Packing Diaphragm Packing Spill Strip Packing	20 mils 20 mils 24 mils 28 mils	15 mils 15 mils 15 mils 50 mils	33% greater than GE's 33% greater than GE's 60% greater than GE's 44% less than GE's. This is the most probable rubbing area.		
	Axial Clearances • Wheel base to diaph inner ring "D" and "P" • Bucket to partition (L') • Bucket shroud to diaph outer ring (N)	Vary Vary Vary	Vary Vary Vary	10% to 60% less than GE's. The Alstom axial clearances D and P (wheel base to diaphragm inner ring, TE) are smaller than the GE's. P clearance is the smallest and most probable rubbing clearance in axial direction, for a rotor long (rotor expands faster than shell or shell contracts faster than rotor) condition. 7% to 34% greater than GE's 1% to 17% greater than GE's		
	High Pressure Heater Extraction Pressure @ VWO	1096 psia	1094 psia	The new pressure is close to the original value		
	1 st Stage Inner Surface Temp	New Location	1 st Stage Inner Shell	Reposition the HP inlet inner surface thermocouple to the steam inlet. The new thermocouples should provide similar outputs in terms of temperature and response. Description will be changed to "HP Inlet Inner Surface Temperature"		

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	TABLE 1 - INTERMOUNTAIN POWER GENERATION TURBINE RETROFIT MAJOR INTERFACE LIST				
No	Description	Alstom	CE	Effect or Comments	
	1 st Stage Pressure	New Location	1 st Stage Inner Shell	The 1st stage pressure is used by the boile controls as a measure of steam flow. With f arc admission the HP inlet pipe pressure is proportional to steam flow, therefore it is normal practice to use inlet pipe pressure place of 1st stage pressure as a measure of steam flow.	
				Re-pipe the existing 1st stage pressure transmitter to the new HP loop pipe pressur tapping is required. The transmitter may require re-ranging to suit the higher press (IPSC) in accordance with ALSTOM flow/press curve TS 29367	
	IP Rotor Cooling Steam	816F	829F	ок	
en e	HP Differential Expansion Alarms (DX1): • Rotor Long Alarm Hi-Hi • Rotor Long Alarm • Cold Set (reference) • Rotor Short Alarm • Rotor short Alarm Hi-Hi	+0.430" +0.400" 0.000" -0.150" -0.170"	0.200" 0.230" 0.630" 0.780" 0.800"	The new HP turbine is consistent with the existing GE differential expansion alarm ar limit values.	
	Rotor Vibration Alarms	No Change	GE	High speed balance up to 4300 rpm indicated max peak to peak vibration of less than 0.7 mils.	
	Bearing Temperature Alarms	No Change	GE	OK	
	HP Water Detection, Tops and Bottoms	No Change	GE	OK	

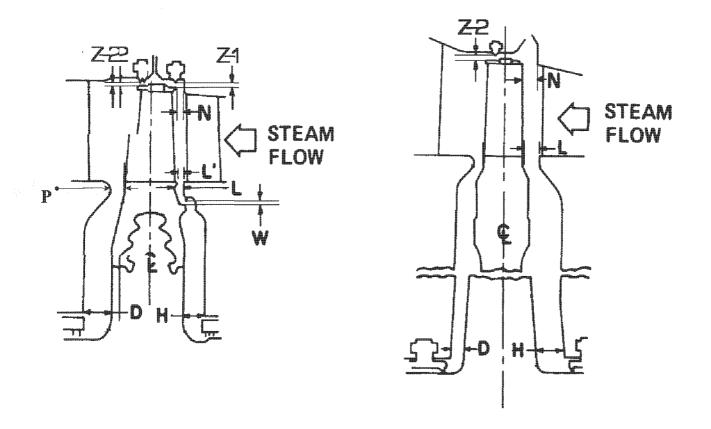


Figure 1: Steam Path Clearances

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: George W. Cross

Page <u>1</u> of <u>1</u>

FROM:

Dennis K. Killian

DATE:

February //, 2002

SUBJECT: Summary of HP Retrofit Operational Issues

We recommend following the shutdown, startup, and operation of the turbine in accordance with the GE existing procedures. According to Alstom, the operation procedures, including startup and shutdown of the retrofitted turbine, are the same as the existing GE procedures. However, the reduction of the radial spill strip and turbine end axial clearances require absolute, adherence to the GE procedures. The eccentricity, rotor prewarming, chest warming, steam-to-turbine temperature matching, thermal stress control, differential expansion, and speed hold mandatory procedures are critical for a successful turbine startup.

The HP retrofit consists basically of a new rotor and a new inner cylinder assembly including diaphragms, variable packings, and steam inlet connections. The original HP outer shell, N1 and N2 packing casings, and packing rings are retained.

Control of steam entering the HP is converted to full arc admission. Generally the instrumentation is arranged to monitor the same conditions as before to minimize disturbance of existing systems. The option of using the partial arc mode to control rotor long will no longer be available.

Major interface changes and effects are listed in the attached Table 1. Steam path clearances are listed in the HP Wheel Clearance Data Table.

Please direct questions or comments to Phong Do at ext. 6475.

PTD/JHN:

Attachments

cc:

Norman A. Mincer Joe D. Hamblin

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	TABLE 1 - INTERMOUNTAIN	POWER GEN	ERATION TU	RBINE RETROFIT MAJOR INTERFACE LIST
No	Description	Alstom	GE	Effect or Comments
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	Control Valve Change to Full Arc	Full Arc	Partial or Full Arc	All four CVs open or close simultaneously. There will no longer be any choice between partial arc and full arc operation. ALSTOM is providing (through Novatech) new digital position boards for the HP control valves. Some minor wiring changes will also be required within the governor panel and full instructions for this work will be provided. Following fitting of the new boards, it will be necessary to stroke the valves to set up the full open and full closed positions.
	Startup	Adhere to GE's	GE	No change. All starts are to be performed in according to the existing GE instructions using HP Inlet inner surface temperature in place of 1st stage inner surface temperature. However, the reduction of the radial spill strip and turbine end axial clearances require an absolute adherence to the GE procedures.
	Shutdown	Adhere to GE's	GE	All shutdowns are to be performed to the existing GE instructions.
	Normal Operation	Adhere to GE's	GE	Operation, rates of loading and unloading remain as per the existing GE instructions.

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	Axial Clearances Turbine end, wheel base to diaph inner ring "D" and "P" Bucket to partition,	Vary	Vary	10% to 60% less than GE's. The Alstom axial clearances D and P (wheel base to diaphragm inner ring, TE) are smaller than the GE's. The "P" clearance is the smallest and most probable rubbing clearance in axial direction, for a rotor long (rotor expands faster than shell or shell contracts faster than rotor) condition.
	generator end, (L') • Bucket shroud to diaph outer ring, generator end, (N)	Vary Vary	Vary Vary	7% to 34% greater than GE's 1% to 17% greater than GE's
	High Pressure Heater Extraction Pressure @ VWO	1096 psia	1094 psia	The new pressure is close to the original value
	1 st Stage Inner Surface Temp	HP Inlet	1 st Stage Inner Shell	Reposition the HP inlet inner surface thermocouple to the steam inlet. The new thermocouples should provide similar outputs in terms of temperature and response. Descriptions in the GE instruction manual and TGSI will be changed to "HP Inlet Inner Surface Temperature" from "1st Stage Shell Metal Temperature"

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No	Description	Alstom	GE CONTRACTOR	Effect or Comments
	1 st Stage Pressure	HP Leads Upstream of Bowl	1 st Stage Inner Shell	The 1st stage pressure is used by the boiler controls as a measure of steam flow. With full arc admission the HP inlet pipe pressure is proportional to steam flow, therefore it is normal practice to use inlet pipe pressure in place of 1st stage pressure as a measure of steam flow.
				Re-pipe the existing 1st stage pressure transmitter to the new HP loop pipe pressure tapping is required. The transmitter may require re-ranging to suit the higher pressure (IPSC) in accordance with ALSTOM flow/pressure curve TS 29367
	IP Rotor Cooling Steam	816F	829F	ок
	HP Differential Expansion Alarms (DX1): Rotor Long Alarm Hi-Hi Rotor Long Alarm Cold Set (reference) Rotor Short Alarm Rotor short Alarm Hi-Hi	+0.430" +0.400" 0.000" -0.150" -0.170"	0.200" 0.230" 0.630" 0.780" 0.800"	The new HP turbine is consistent with the existing GE differential expansion alarm and limit values.
	Rotor Vibration Alarms	No Change	GE	High speed balance up to 4300 rpm indicated maximum peak to peak vibration of less than 0.75 mils.
	Bearing Temperature Alarms	No Change	GE	OK
	HP Water Detection, Tops and Bottoms	No Change	GE	OK

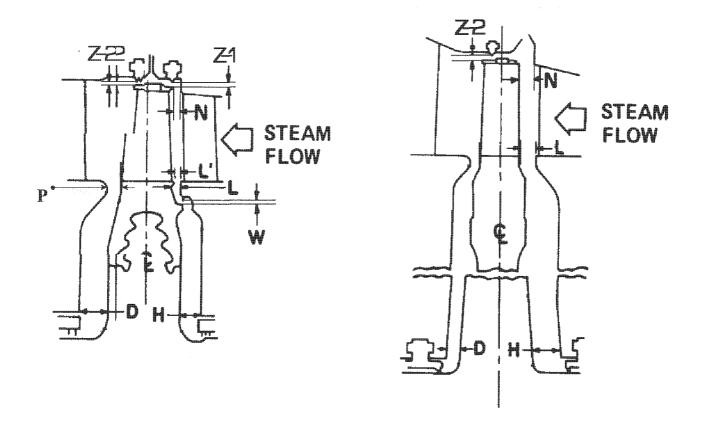


Figure 1: Steam Path Clearances

				HP W	HEEL C	Lie arai	ICE DA	ra (OPE	NING)				
LO			WHEEL'	TO DIAPHI	RAGM AX	IAL CLE	ARANCE		151 x 143 (27) x 252 x 3	WHE	LL RADIA	AL CLEAR	ANCE
NO		D	P (E)	H	L	ĽL	L'R	NL	NR	Z-1L	Z-1R	Z-21	Z-2R
TE	А												
8	E _{as}	0.689	0.500	0.343	N/A	0.268	0.268	0.224	0.224	0.031	0.031	0.031	0.031
	E _{ge}												
	D _(A-ge)												
	D _(Eas - Ege)	N/A	N/A	0.343	N/A	0.268	0.268	0.224	0.224	0.031	0.031	0.031	0.031
TE	Α												
7	E _{as}	0.547	0.496	0.343	N/A	0.268	0.268	0.224	0.224	0.030	0.030	0.030	0.030
	E _{ge}	1.260	0.695	0.534	0.390	0.250	0.250	0.222	0.222	NA	NA	0.050	0.050
	D _(A-ge)												
	D _(Eas - Ege)	-0.713	-0.199	-0.191	N/A	0.018	0.018	0.002	0.002	0.030	0.030	-0.020	-0.020
	A												
6	E _{as}	0.547	0.484	0.366	N/A	0.287	0.287	0.224	0.224	0.028	0.028	0.028	0.028
	E _{ee}	0.608	0.639	0.563	0.380	0.240	0.240	0.208	0.208	0.050	0.050	0.050	0.050
	D _(A-ge)	-0.061	-0.155	-0.197	N/A	0.047	0.047	0.016	0.016	-0.022	-0.022	-0.022	-0.022
L		1 0.001	1 0.100	1 0.2.2.7				0.0.0	0.010	0.022	"0.022	-0.022	0.0
	A	0.001	0.100					0.010	0.010	0.022	*0.022	-0.022	
5		0.524	0.472	0.378	N/A	0.299	0.299	0.224	0.224	0.028	0.028	0.028	0.028
5	A												
5	A E _{as}	0.524	0.472	0.378	N/A	0.299	0.299	0.224	0.224	0.028	0.028	0.028	0.028
5	$egin{array}{c} A & & & & & & & & & & & & & & & & & & $	0.524	0.472	0.378	N/A	0.299	0.299	0.224	0.224	0.028	0.028	0.028	0.028
	$\begin{array}{c} A \\ \\ E_{gs} \\ \\ E_{gc} \\ \\ D_{(A\text{-}ge)} \end{array}$	0.524	0.472	0.378	N/A 0.370	0.299	0.299	0.224	0.224 0.199	0.028	0.028	0.028	0.028
5	A E_{ge} $D_{(A-ge)}$ $D_{(Ess-Ege)}$	0.524	0.472	0.378	N/A 0.370	0.299	0.299	0.224	0.224 0.199	0.028	0.028	0.028	0.028
	A E_{as} E_{ge} $D_{(A-ge)}$ $D_{(Eas-Ege)}$ A	0.524 0.679 -0.155	0.472	0.378	N/A 0.370 N/A	0.299 0.230 0.069	0.299 0.230 0.069	0.224 0.199 0.025	0.224 0.199 0.025	0.028	0.028	0.028	0.028
	A E_{gg} $D_{(A-gg)}$ $D_{(Eas-Egg)}$ A E_{gg}	0.524 0.679 -0.155	0.472 0.650 -0.178	0.378 0.711 -0.333 0.382	N/A 0.370 N/A N/A	0.299 0.230 0.069 0.295	0.299 0.230 0.069	0.224 0.199 0.025	0.224 0.199 0.025	0.028 0.050 -0.022	0.028 0.050 -0.022	0.028 0.050 -0.022	0.028 0.050 -0.022
	A E_{gg} $D_{(A-gg)}$ $D_{(Eas-Eag)}$ A E_{gg}	0.524 0.679 -0.155	0.472 0.650 -0.178	0.378 0.711 -0.333 0.382	N/A 0.370 N/A N/A	0.299 0.230 0.069 0.295	0.299 0.230 0.069	0.224 0.199 0.025	0.224 0.199 0.025	0.028 0.050 -0.022	0.028 0.050 -0.022	0.028 0.050 -0.022	0.028 0.050 -0.022
	A E_{as} E_{gc} $D_{(A-ge)}$ $D_{(E_{SS}-E_{RE})}$ A E_{as} E_{gc} $D_{(A-ge)}$	0.524 0.679 -0.155 0.504 0.648	0.472 0.650 -0.178 0.453 0.706	0.378 0.711 -0.333 0.382 0.524	N/A 0.370 N/A N/A 0.360	0.299 0.230 0.069 0.295 0.220	0.299 0.230 0.069 0.295 0.220	0.224 0.199 0.025 0.221 0.188	0.224 0.199 0.025 0.221 0.188	0.028 0.050 -0.022 0.028 0.050	0.028 0.050 -0.022 0.028 0.050	0.028 0.050 -0.022 0.028	0.028 0.050 -0.022 0.028 0.050
	A E ₃₅ E _{ge} D _(A-ge) D _(Ess-Ege) A E _{gg} D _(A-ge) D _(Ess-Ege)	0.524 0.679 -0.155 0.504 0.648	0.472 0.650 -0.178 0.453 0.706	0.378 0.711 -0.333 0.382 0.524	N/A 0.370 N/A N/A 0.360	0.299 0.230 0.069 0.295 0.220	0.299 0.230 0.069 0.295 0.220	0.224 0.199 0.025 0.221 0.188	0.224 0.199 0.025 0.221 0.188	0.028 0.050 -0.022 0.028 0.050	0.028 0.050 -0.022 0.028 0.050	0.028 0.050 -0.022 0.028	0.028 0.050 -0.022 0.028 0.050
4	A E ₃₅ E ₂₆ D _(A-2e) D _(Eas-Eee) A E ₃₅ E ₃₆ D _(A-2e) A	0.524 0.679 -0.155 0.504 0.648	0.472 0.650 -0.178 0.453 0.706	0.378 0.711 -0.333 0.382 0.524	N/A 0.370 N/A N/A 0.360 N/A	0.299 0.230 0.069 0.295 0.220	0.299 0.230 0.069 0.295 0.220	0.224 0.199 0.025 0.221 0.188	0.224 0.199 0.025 0.221 0.188	0.028 0.050 -0.022 0.028 0.050	0.028 0.050 -0.022 0.028 0.050	0.028 0.050 -0.022 0.028 0.050	0.028 0.050 -0.022 0.028 0.050 -0.022
4	$\begin{array}{c} A \\ E_{3s} \\ E_{ge} \\ D_{(A-ge)} \\ D_{(Eas-Eee)} \\ A \\ E_{3s} \\ E_{ge} \\ D_{(A-ge)} \\ D_{(Eas-Eee)} \\ A \\ E_{3s} \end{array}$	0.524 0.679 -0.155 0.504 0.648 -0.144	0.472 0.650 -0.178 0.453 0.706 -0.253	0.378 0.711 -0.333 0.382 0.524 -0.142	N/A 0.370 N/A N/A 0.360 N/A	0.299 0.230 0.069 0.295 0.220 0.075	0.299 0.230 0.069 0.295 0.220 0.075	0.224 0.199 0.025 0.221 0.188 0.033	0.224 0.199 0.025 0.221 0.188 0.033	0.028 0.050 -0.022 0.028 0.050 -0.022	0.028 0.050 -0.022 0.028 0.050 -0.022	0.028 0.050 0.022 0.028 0.050 0.022	0.028 0.050 -0.022 0.028 0.050 -0.022
4	A E ₃₅ E ₂₆ D _(A-ge) D _(Eas-Ege) A E ₃₅ E ₂₆ D _(A-ge) A E ₃₅ E _{ge}	0.524 0.679 -0.155 0.504 0.648 -0.144	0.472 0.650 -0.178 0.453 0.706 -0.253	0.378 0.711 -0.333 0.382 0.524 -0.142	N/A 0.370 N/A N/A 0.360 N/A	0.299 0.230 0.069 0.295 0.220 0.075	0.299 0.230 0.069 0.295 0.220 0.075	0.224 0.199 0.025 0.221 0.188 0.033	0.224 0.199 0.025 0.221 0.188 0.033	0.028 0.050 -0.022 0.028 0.050 -0.022	0.028 0.050 -0.022 0.028 0.050 -0.022	0.028 0.050 0.022 0.028 0.050 0.022	0.028 0.050 -0.022 0.028 0.050 -0.022

				HP W	HEEL C	LEARAI	ICE DA	TA (OPE	NING)				
2			WHE	WHELL RADIAL CLEARANCE									
NO	100 mm	D	P(E)	H	зL	ĽL	L'R	NE	NR	Z-IL	Z-1R	Z-2L	Z-2R
	E _{as}	0.457	0.406	0.374	N/A	0.283	0.283	0.197	0.197	0.043	0.043	0.043	0.043
	E _{ge}	0.679	0.720	0.726	0.340	0.200	0.200	0.166	0.166	0.050	0.050	NA	NA
	D _(A-ge)												
	D _(Egg-Eas)	-0.222	-0.314	-0.352	N/A	0.083	0.083	0.031	0.031	-0.007	-0.007	0.043	0.043
	A												
1	\mathbf{E}_{as}	0.457	0.406	0.276	N/A	0.213	0.213	0.185	0.185	0.028	0.028	0.028	0.028
	E _{ee}	1.470	0.729	NA	0.470	0.210	0.210	0.210	0.210	0.050	0.050	NA	NA
	D _(A-ge)												
	D _(Ege-Eas)	-1.013	-0.323	0.276	N/A	0.003	0.003	-0.025	-0.025	-0.022	-0.022	0.028	0.028
GE	A												
1	E _{as}												
	E_{ge}	NA		NA	0.550	0.290	0.290	0.290	0.290	0.050	0.050	NA	NA
	D _(A-se)												
	D _(Ege-Eas)												
Com	pleted By: P	hong Do			*****************		***************************************			Date: 2/14	1/02	***************************************	

			HP DIAPH	RAGM P	ACKING	CLEARA	NCE AND	WEAR N	IEASU	REME	VT (OP	ENING			
р	haphragi	m				Rad	lial, A			Pack	ing Ring	Height	(Ht)		
Sta	Rn	Fig		X Second	Y	Left	Right	(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	2	3	4	5	6	7	8
TE			Α												
7		1	E _{as}	0.230	0.423	0.024	0.024								
			Ege	0.340	0.500	0.015	0.015								
			D _(A-ge)												
			D (ge-as	-0.110	-0.077	0.009	0.009								
			A												
6	R2	1	E _{as}	0.250	0.403	0.024	0.024								
			E_{ge}	0.340	0.500	0.015	0.015								
			D _(A-ge)						40						
			D (ge-as	-0.090	-0.097	0.009	0.009								
			A												
6	R1	1	E_{as}	0.250	0.403	0.024	0.024								
			E_{re}	0.340	0.500	0.015	0.015								
			D _(A-ge)	0.000	0.000										
			D _{(ge-as}	-0.090	-0.097	0.009	0.009								
		_	A	0.309	0.423	0.024	0.024								
5	R2	1	$rac{ ext{E}_{ ext{as}}}{ ext{E}_{ ext{ge}}}$	0.345	0.423	0.024	0.024								
			D _(A-ge)	0.5 (3	0.505	0.015	0.013								
			D _{(ge-as}	-0.036	-0.082	0.009	0.009								
		***************************************	A												
5	R1	1	E_{as}	0.309	0.423	0.024	0.024								
			$\rm E_{\rm ge}$	0.345	0.505	0.015	0.015								
			D _(A-ge)	***************************************	nusiani3A******unaan	mannininkihiki/1918+14m									
			D (sc-as	-0.036	-0.082	0.009	0.009								
			A	************	**************************************	***************************************	Managary and the second		·						
4	R2	1	E _{as} _	0.309	0.423	0.024	0.024								
			E _{re}	0.312	0.412	0.015	0.015								
			D _(A-ge)												
			D (ge-as	-0.003	-0.011	0.009	0.009								

			HP DIAPH	RAGM P.	ACKING	CLEARA	NCE AND	WEARM	(EASU)	REMEN	VT (OP	ENING		
Γ)iaphrag	n			F her	Rac	lial, A			Pack	ing Ring	Height ((Ht)	
			A	X	Y									
4	R1	1	E _{as}	0.309	0.423	0.024	0.024							
			E _{ge}	0.312	0.412	0.015	0.015							
			D _(A-ge)											
			D _{(se-as}	-0.003	-0.011	0.009	0.009							
			A											
3	R2	1	E _{as}	0.289	0.364	0.024	0.024							
			E_{ge}	0.312	0.412	0.015	0.015							
			D _(A-ee)											
			D (ge-as	-0.023	-0.048	0.009	0.009			AMOODIOODIO				
			A											
3	R1	1	E _{as}	0.289	0.364	0.024	0.024							
			E _{ge}	0.312	0.412	0.015	0.015							
			D _(A-gc)		******									
			D (ge-as	-0.023	-0.048	0.009	0.009			pomocni donia			011000111000111000	
			A											
2	R2	1	E _{as}	0.290	0.365	0.033	0.033							
			E _{ge}	0.312	0.412	0.015	0.015							
			D _(A-ee)											
			_D	-0.022	-0.047	0.018	0.018							
			A											
2	R1	1	E _{as}	0.290	0.365	0.033	0.033							
			E_{ge}	0.312	0.412	0.015	0.015							
			D _(A-ge)	0.05-			0.010							
		1	<u>n</u>	-0.022	-0.047	0.018	0.018			aaniaoonoonia				
1	R1	1	A											
			E _{as}											
			E _{ee}											
			D _(A-ee)		440000		***************************************							
Comm	leted By		Phong Do						Date	2/14/02				
Сошр	reted by	. I	nong DO						Daic.	4/ 17/UZ		***************************************		

				HP "NI" P	ACKING CL	EARANCE A	AND WEAR	MEASU	IREMEN	ITS (OPI	ENING)				
	Pkg Head	ls				Ra	dial			Pa	eking Ri	ng Heigh	t (Ht)		
Sta	Rng	Fig		X	Y	Left	Right	11.	2	3	4	-5	6	7	8
			Α											Taranta de la constanta de la	
N1	1	2	E _{as}	0.290	0.550	0.025	0.025								
			E _{ee}	0.290	0.550	0.025	0.025				į				
			D _(A-ge)			0.000					İ				
	Давизавичасника и	oo o o o o o o o o o o o o o o o o o o	D (ge-as	0.000	0.000	0.000	0.000								
			Α		014-0011100111001110011100										
NI	2	1	E _{as}	0.290	0.550	0.025	0.025								
			E_{ge}	0.290	0.550	0.025	0.025								
			D _(A-ge)										Militaria de la composição de la composi		
	401140000000000000000000000000000000000	***************************************	D (ge-as	0.000	0.000	0.000	0.000		4011000110001						1000100011000110001
			A												
N1	3	1	E _{as}	0.290	0.550	0.020	0.025								
			E _{ee}	0.290	0.550	0.015	0.015								
	-		D _(A-ge)	rippomonuomonuomo	**************************************		•••••••								
			D (ge-as	0.000	0.000	0.005	0.010								
			A		o was a second										
N1	4	1	E _{as}	0.290	0.550	0.020	0.020								
			E _{ge}	0.290	0.550	0.015	0.015								
			D _(A-ge)												
			D (ge-as	0.000	0.000	0.005	0.005	***************************************						***************************************	
NI	5	1	Α												
141	,	4	E _{as}	0.290	0.550	0.020	0.020								
			E _{ge}	0.290	0.550	0.015	0.015								
			$\mathbf{D}_{(\mathrm{A-ge})}$			NAME AND ADDRESS OF THE PARTY O									
		***************************************	D (ge - as	0.000	0.000	0.005	0.005		201120112					*******	
Nl	6	1	A	-,											
		-	E _{as}	0.290	0.550	0.020	0.020								
			E _{ge}	0.290	0.550	0.015	0.015								
			D _(A-ge)		***************************************										
			D (ee-as	0.000	0.000	0.005	0.005							Applications and the same	

				HP "NI" P	ACKING CL	EARANCE	AND WEA	TEAR MEASUREMENTS (OPENING)
	Pkg Hea	ds				R	adial	Packing Ring Height (Ht)
			A	Х	Y			
NI	7	1	E _{ss}	0.290	0.550	0.020	0.020	
			Ege	0.290	0.550	0.015	0.015	5
		-	$D_{(A-ge)}$					
			D (ge-as	0.000	0.000	0.005	0.005	5
Comp	leted By:	Phong D	0			_		Date: 2/14/02